6. A system for controlling drag and vortex induced vibration consisting of a substantially cylindrical marine element having an ultra-smooth substantially cylindrical sleeve surrounding the marine element with a K/D roughness parameter of 1.0 X 10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the cylindrical sleeve.

REMARKS

Attorney first wishes to thank Examiners Knight and Mitchell for their time and further clarification of the reasons for rejection of claims 1 – 6 during the telephonic interview of 07 November 2002.

<u>Rejection of Claims 1 – 6 Under 35 U.S.C. § 103(a)</u>

a. <u>Rejection over Blevins '614 and Cited Articles</u>

In Paragraphs 2 and 3 of the Final Office Action, the Examiner rejects claims 1 – 6 as being obvious over US Patent 6,206,614 to Blevins, in view of Sellens, R., <u>Mech 441</u>: Losses In Piping, CE/ME 101 abc handout #5, Incompressible Flow over a Circular Cylinder; or Drag of Blunt Bodies and Streamlined Bodies; or Transition Prediction in Flow over Roughness Elements or the August 20, 2001 email from Prof. Smits regarding smooth surfaces on reducing turbulent flow (collectively, the "Cited Articles"). Attorney respectfully traverses the rejection.

Blevins '614 addresses VIV suppression based on relative position of two or more bluff or cylindrical bodies (col. 4, lines 13 – 45). The Examiner states that Blevins '614 is silent on construction or materials and do not teach the specific feature that the surface or surface coating is smooth within the claimed K/D range. The Examiner then takes official notice that smooth surfaces are known to create less turbulent flow than rough surfaces. The Examiner then cites the above references to reach the conclusion that it would have been obvious to one of ordinary skill in the art to include sleeves or fairings of Blevins '614 with smooth surfaces or coatings having a K/D range claimed in order to minimize drag and friction.

In taking official notice, the Examiner fails to point out how any of the articles cited suggest that a reduction in surface roughness relates to a reduction in VIV. A reduction in roughness can lead to a reduction in friction and less turbulent flow. However, as noted in the previously submitted Allen Declaration ¶7 (Exhibit A to the Response to Office Action, filed August 27, 2002), VIV can occur in <u>laminar or turbulent flow regimes</u>. Thus, a reduction in

turbulence, as a function of a reduction in surface roughness, does not directly lead a reduction in VIV. Nor does a reduction in drag directly lead to reduction in VIV. Allen Declaration ¶¶7, 15 – 17. While the CE/ME101 handout depicts a Von Karaman vortex street, it does not in any way disclose, teach or suggest that smoother surface leads to a reduction in VIV. Nor does a reduction in drag necessarily result in a reduction in VIV. However, the converse is true, in that an increase in VIV will lead to an increase in drag. Allen Declaration ¶17.

The suggested combination of Blevins '614 with any of the articles suggests is that if one coated the structures of Blevins '614, a decrease in friction and turbulence could result. However, there is nothing to suggest that a further reduction in VIV response would result from the ultra-smooth surface. Indeed, the VIV suppression of Blevins '614 would still be a function of the spacing of the cylindrical bodies. There is nothing in the combination of Blevins '614 with any of the articles that suggest that an ultra-smooth coating would lead to a reduction in VIV response. At most they teach VIV suppression as a function of spacing and a reduction in turbulent flow about the columns. The addition of a smooth-surface about the structure of Blevins '614 does not in any way disclose, teach or suggest a reduction in drag and VIV response as a result of the smoothness.

During the telephonic interview, it was stated that the claim structure of claims 1 – 6 were open ended such that it would allow more than one column or sleeve, thereby resulting in multiple risers or fairings, which could be spaced in the manner of Blevins '614. This was an issue not previously raised in the prior Office Actions or the Final Office Action. Attorney has amended claims 1 – 6 to move to a closed claim structure, by use of the transition term "consisting." It is axiomatic that the use of the closed transition term excludes additional elements not recited in the claim language. *See*, *AFG Indus., Inc. v. Asahi Glass Co., Ltd.*, 239 F.3d 1239, 1245 (Fed. Cir. 2001) ("In contrast, "closed" transition phrases such as "consisting of" are understood to exclude any elements, steps, or ingredients not specified in the claim.")

As such, the claims are directed to a method and system in which a single sleeve/surface/coating having a smoothness in the required range about a substantially cylindrical marine is used to reduce drag and VIV. The suggested combination of Blevins '614 and the cited articles does not disclose, teach or suggest that a reduction in drag and VIV can be achieved by a single ultra-smooth surface in the claimed range. Accordingly, claims 1 – 6 are patentable over Blevins '614 and the Cited Articles.

b. Rejection over Gregory '722 and the Roberson Text

In Paragraph 4 of the Office Action, the Examiner rejects claims 1 – 6 under §103(a) as being obvious in view of U.S. Patent 4,470,722 to Gregory in view of Roberson and Crow,

Engineering and Fluid Mechanics, 5th Ed., Houghton Mifflin Co. © 1193, chapter 10, pages 428-429 ("Roberson"). Attorney respectfully submits that to the extent the Blevins and Cited Articles rejection is overcome, (a) the combination of Gregory '722 and Roberson is newly and improperly presented on Final Rejection; (b) the Final Rejection should be withdrawn where the sole remaining basis for rejection is the combination of Gregory '722 and Roberson.

The Examiner states that while "ultra-smooth" is never explicitly stated by Gregory '722l the applicant stating in page 5, line 23 – page 6, line 4 that the "ultra-smooth" surface could be provided by sleeves made of copper, carbon fiber, rubber or any sufficiently smooth thermoplastic, metal alloy or other material. The Examiner, erroneously, goes on to state that applicant did not place any further restriction on the materials listed and that one of ordinary skill would use "standard materials." On page7, lines 15 - 16 of the specification, it states "[w]hile there are many ways to provide it, [the surface] ***a critical aspect is the ultrasmooth surface***." (emphasis and bracketed material added). The specification goes on to define K/D ratio and what is considered to be ultrasmooth. Accordingly, any material or surface treatment, as used within the present invention, must have a smooth surface within the required range. It is incorrect to state that applicant did not place any restrictions or limitations on the materials cited.

The Examiner's argument regarding the use of standard materials by one of ordinary skill in the art is likewise misplaced. The specification does not suggest that "standard" materials were used. Indeed, the Allen Declaration ¶11, specifically notes how "standard materials" were insufficient to meet the desired smoothness and required specific preparation. The fact that the specification does not detail any methods used in surface preparation is irrelevant – whatever material or coating is used, it must exhibit a smoothness in the required range.

The Roberson reference addresses the use of a parameter known as equivalent sand roughness (k_s) and that the values set forth in the Roberson reference appearing in Fig. 10.8 at page 428 are indicative of the smoothness of standard materials. During the telephonic interview, Attorney distinguished between k_s and K as measured within the context of the claimed invention. The present method of measuring K, i.e., the average peak to trough distance of the surface roughness, is the same as the parameter, Ra, as is more fully described in Dane, H.J., *Upstream Pipe Wall Roughness Influence on Ultrasonic Flow Measurement,* Sec. 2, as may be found at www.gtonline.org/ref/member/library/cga1999/(18)dane.gif.

Conversely, k_s is an empirically derived parameter which is the equivalent height of a grain of sand on a surface that produces actual measured resistance coefficient. A discussion of the relation between K, as measured herein, equivalent sand roughness and Nikuradse sand

roughness may be found at http://www.water.hut.fi/pdl/mkummu masters thesis.pdf at Sec. 2.4.1. From this it can be seen that sand roughness is also a function of the rate of flow (u_z) in Eq. 31 therein. The parameter K, as used herein and in the above referenced thesis, is an absolute measurement and that the ratios of k_s/D and K/D are not equivalent.

Attorney respectfully submits that the reference to sand roughness k_s is irrelevant with respect to the measurement of K as described in the specification at page 8, lines 9-10 and as known in the art, pursuant to the Dane reference. Indeed, the Interview Summary Record states that Roberson is simply to demonstrate the relative smoothness of one material relative to the other. The Examiner has failed to point to any reference which would suggest that standard materials would have the desired smoothness, such that in combination with Gregory '722, anticipates the claimed invention.

Attorney further notes that the Examiner has ignored the case law of the Federal Circuit which specifically rejected the argument now made by the Examiner. *See*, *Crown Operations Int'l Ltd. v. Solutia, Inc.*, 289 F.3d 1367, 1377 (Fed. Cir. 2002) which states that if a limitation is inherently disclosed, it must necessarily be present and a person of ordinary skill would recognize its presence. Further, inherency may not be established by probabilities or possibilities. *Id.* Attorney respectfully submits that Dr. Allen's statement, as one of at least ordinary skill in the art, regarding the unsuitability of "standard" materials and the required preparation goes to the lack of recognition of inherency by one of ordinary skill in the art as noted in *Crown Operations* and teaches away from the inherence argument made by the Examiner.

As such, the combination of Gregory '722 and Roberson does not disclose, teach or suggest that a surface having the required smoothness. Attorney respectfully submits that claims 1 – 6 are patentable over the cited references.

Conclusion

Attorney respectfully Attorney requests that the above amendments be entered and submits that all of the bases for rejection in the Final Office Action have been fully addressed and that the claims, as amended, are patentable over the cited art. To the extent the Blevins-based rejection has been overcome, Attorney respectfully submits that the Roberson reference constitutes newly cited art and that the finality of the Office Action with respect for the Gregory/Roberson basis for rejection is premature.

Attorney invites the Examiner to call at the phone number listed below if there are any questions or issues with respect to this response prior to the issuance of any written action in this case.

Respectfully submitted,

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APPENDIX A

1. (Second Amended) A method of controlling drag and vortex induced vibration in a substantially cylindrical element [comprising] consisting of providing an ultra-smooth surface about the cylindrical element having a K/D ratio of 1.0×10^{-4} or less where:

K is an average measure surface peak to through distance and

D is an effective outside diameter of the cylindrical element.

2. (Third Amended) A method of controlling drag and vortex induced vibration about a substantially cylindrical marine element [by providing] consisting of an ultra-smooth surface coating about the cylindrical element having a K/D ratio of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the coating.

3. (Third Amended) A method of controlling drag and vortex induced vibration about a substantially cylindrical marine element [by providing] consisting of an ultra-smooth surface substantially cylindrical sleeve about the cylindrical element having a K/D ratio of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element, including the sleeve.

4. (Second Amended) A system for controlling drag and vortex induced vibration, [comprising] consisting of:

a substantially cylindrical marine element have an ultra-smooth effective surface with a K/D roughness parameter of about 1.0×10^{-4} or less, where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element, including the sleeve.

5. (Third Amended) A system for controlling drag and vortex induced vibration [comprised] consisting of a substantially cylindrical marine element having an ultra-smooth coating material with a K/D roughness parameter of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the coating.

6. (Third Amended) A system for controlling drag and vortex induced vibration [comprised] consisting of a substantially cylindrical marine element having an ultra-smooth substantially cylindrical sleeve surrounding the marine element with a K/D roughness parameter of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the cylindrical sleeve.